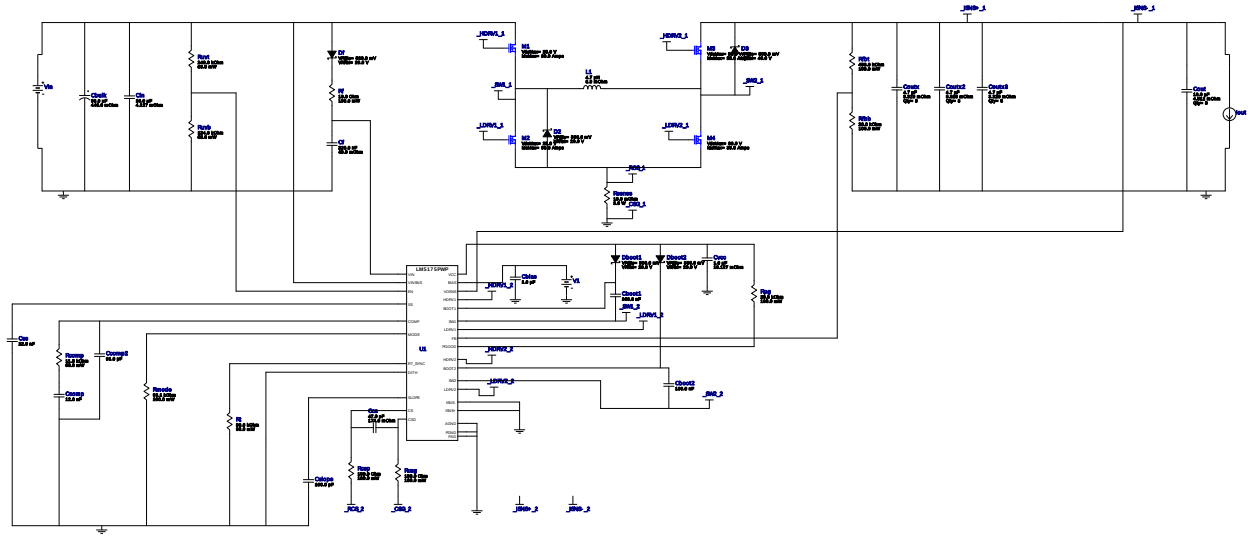
WEBENCH® Design Report

VinMin = 4.0V
VinMax = 10.0V
Vout = 19.0V
Iout = 2.0A

Device = LM5175PWPR
Topology = Buck_Boost
Created = 7/18/16 1:32:00 AM
BOM Cost = $10.03
BOM Count = 53
Total Pd = 3.31W

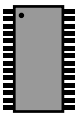
Design : 906020/2253 LM5175PWPR
LM5175PWPR 4.0V-10.0V to 19.00V @ 2.0A

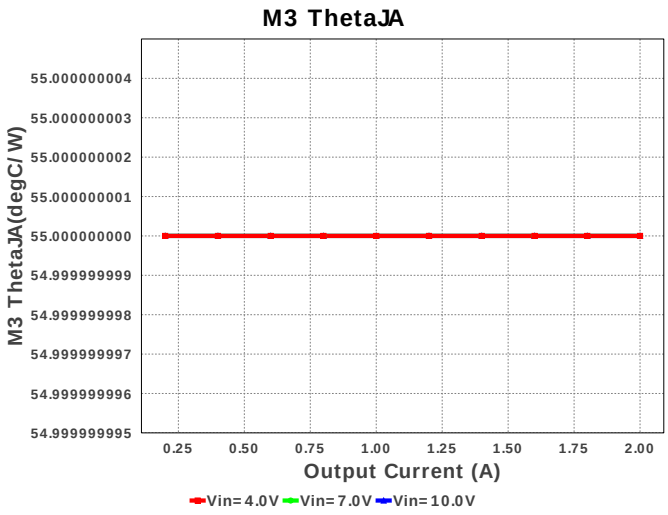


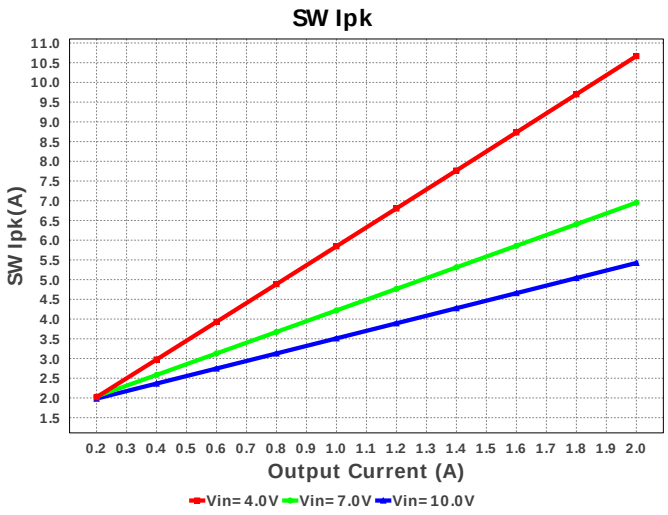
Electrical BOM

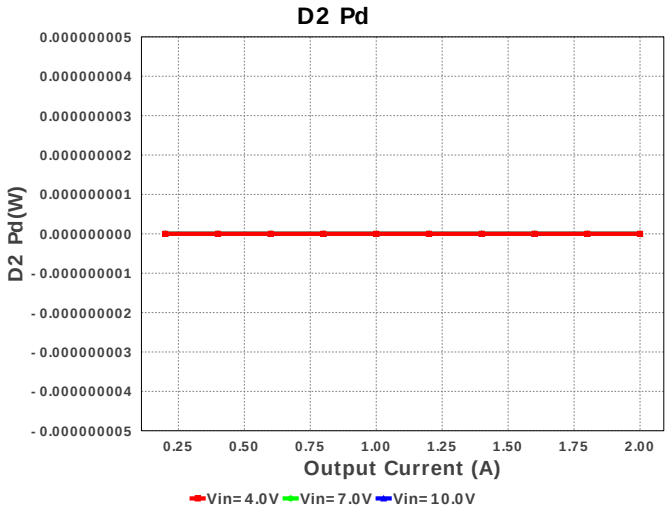
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbias	Taiyo Yuden	GMK212B7105KG-T Series= X7R	Cap= 1.0 uF VDC= 35.0 V IRMS= 0.0 A	1	$0.05	0805 7 mm²
2.	Cboot1	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
3.	Cboot2	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
4.	Cbulk	Nichicon	UUD1C680MCL1GS Series= uD	Cap= 68.0 uF ESR= 440.0 mOhm VDC= 16.0 V IRMS= 230.0 mA	1	$0.11	SM_RADIAL_6.3AMM 80 mm²
5.	Ccomp	MuRata	GRM033C80J123KE01D Series= X6S	Cap= 12.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
6.	Ccomp2	Samsung Electro-Mechanics	CL21C910JBANNNC Series= C0G/NP0	Cap= 91.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
7.	Ccs	AVX	06035A470JAT2A Series= C0G/NP0	Cap= 47.0 pF ESR= 174.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
8.	Cf	Kemet	C0805C224K5RACTU Series= X7R	Cap= 220.0 nF ESR= 46.0 mOhm VDC= 50.0 V IRMS= 2.65 A	1	$0.02	0805 7 mm²
9.	Cin	MuRata	GRM21BR61C106KE15L Series= X5R	Cap= 10.0 uF ESR= 4.127 mOhm VDC= 16.0 V IRMS= 2.46634 A	1	$0.03	0805 7 mm²

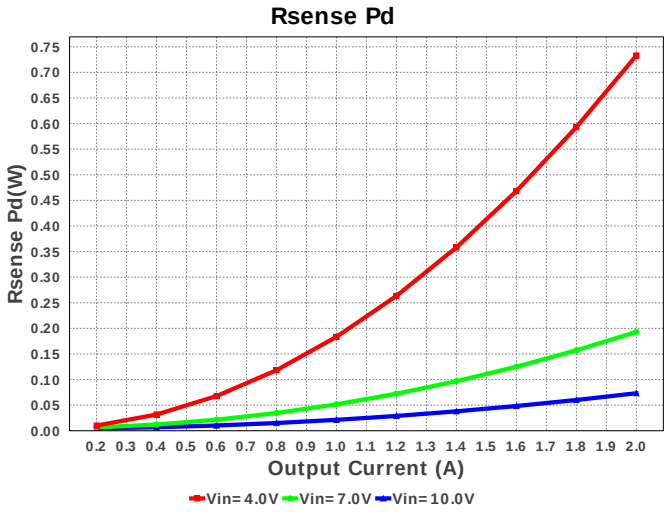
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Cout	MuRata	GRM31CR61E106KA12L Series= X5R	Cap= 10.0 uF ESR= 4.512 mOhm VDC= 25.0 V IRMS= 2.447 A	3	$0.05	 1206_190 11 mm²
11.	Coutx	TDK	C3225X6S1H475K Series= X6S	Cap= 4.7 uF ESR= 3.329 mOhm VDC= 50.0 V IRMS= 0.0 A	5	$0.19	 1210 15 mm²
12.	Coutx2	TDK	C3225X6S1H475K Series= X6S	Cap= 4.7 uF ESR= 3.329 mOhm VDC= 50.0 V IRMS= 0.0 A	5	$0.19	 1210 15 mm²
13.	Coutx3	TDK	C3225X6S1H475K Series= X6S	Cap= 4.7 uF ESR= 3.329 mOhm VDC= 50.0 V IRMS= 0.0 A	5	$0.19	 1210 15 mm²
14.	Cslope	Kemet	C0603C101J3GACTU Series= C0G/NP0	Cap= 100.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0603 5 mm²
15.	Css	Kemet	C0603C223K3RACTU Series= X7R	Cap= 22.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0603 5 mm²
16.	Cvcc	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	$0.01	 0603 5 mm²
17.	D2	Vishay-Semiconductor	SS12-E3/61T	VF@Io= 500.0 mV VRRM= 20.0 V	1	$0.08	 SMA 37 mm²
18.	D3	Vishay-Semiconductor	SS14-E3/61T	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.08	 SMA 37 mm²
19.	Dboot1	Vishay-Semiconductor	SS12-E3/61T	VF@Io= 500.0 mV VRRM= 20.0 V	1	$0.08	 SMA 37 mm²
20.	Dboot2	Vishay-Semiconductor	SS12-E3/61T	VF@Io= 500.0 mV VRRM= 20.0 V	1	$0.08	 SMA 37 mm²
21.	Df	Vishay-Semiconductor	SS12-E3/61T	VF@Io= 500.0 mV VRRM= 20.0 V	1	$0.08	 SMA 37 mm²
22.	L1	Coilcraft	XAL8080-472MEB	L= 4.7 µH DCR= 8.9 mOhm	1	$1.55	 XAL8080 107 mm²
23.	M1	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	$0.44	 TRANS_NexFET_Q3 18 mm²
24.	M2	Texas Instruments	CSD16409Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	$0.37	 TRANS_NexFET_Q3 18 mm²
25.	M3	Texas Instruments	CSD17577Q3A	VdsMax= 30.0 V IdsMax= 35.0 Amps	1	$0.28	 TRANS_NexFET_Q3A 18 mm²
26.	M4	Texas Instruments	CSD17577Q3A	VdsMax= 30.0 V IdsMax= 35.0 Amps	1	$0.28	 TRANS_NexFET_Q3A 18 mm²
27.	Rcomp	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²

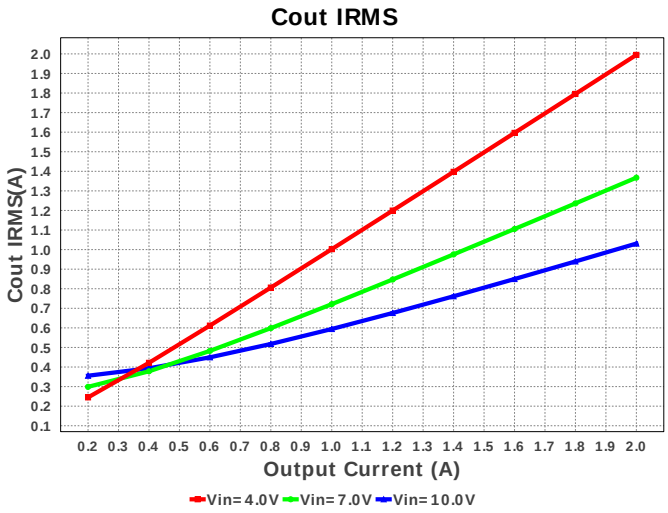
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
28.	Rcsg	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
29.	Rcsp	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
30.	Rf	Vishay-Dale	CRCW060310R0FKEA Series= CRCW..e3	Res= 10.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
31.	Rfbb	Vishay-Dale	CRCW060320K0FKEA Series= CRCW..e3	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
32.	Rfbt	Vishay-Dale	CRCW0603453KFKEA Series= CRCW..e3	Res= 453.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
33.	Rmode	Vishay-Dale	CRCW060393K1FKEA Series= CRCW..e3	Res= 93.1 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
34.	Rpg	Vishay-Dale	CRCW060320K0FKEA Series= CRCW..e3	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
35.	Rsense	Bourns	CRA2512-FZ-R010ELF Series= CRA	Res= 10.0 mOhm Power= 3.0 W Tolerance= 1.0%	1	$0.17	 2512 43 mm^2
36.	Rt	Vishay-Dale	CRCW040280K6FKED Series= CRCW..e3	Res= 80.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
37.	Ruvb	Vishay-Dale	CRCW0402124KFKED Series= CRCW..e3	Res= 124.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
38.	Ruvt	Vishay-Dale	CRCW0402249KFKED Series= CRCW..e3	Res= 249.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
39.	U1	Texas Instruments	LM5175PWPR	Switcher	1	$3.10	 PWP0028F_N 98 mm^2

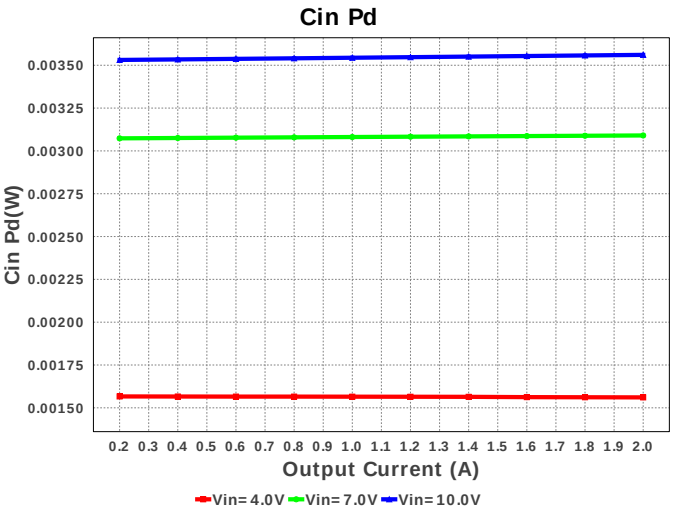


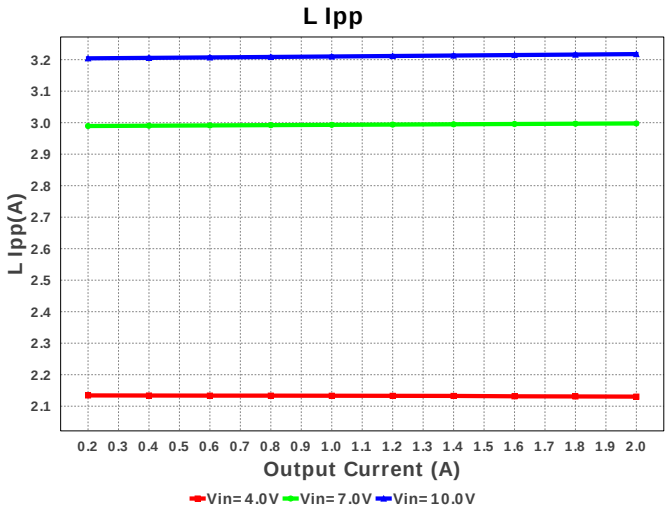


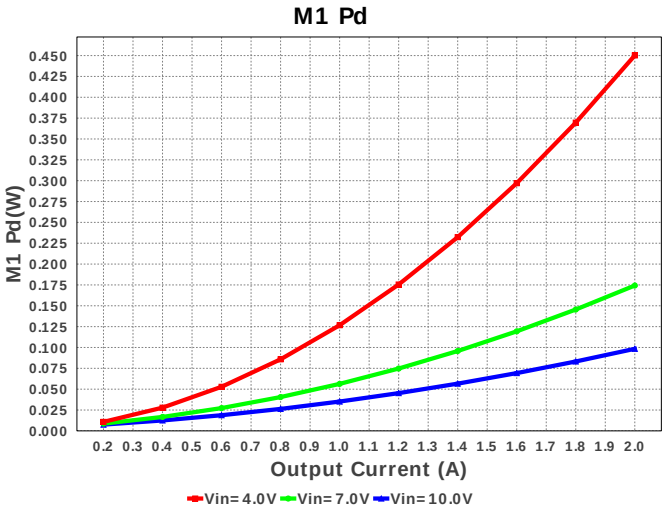


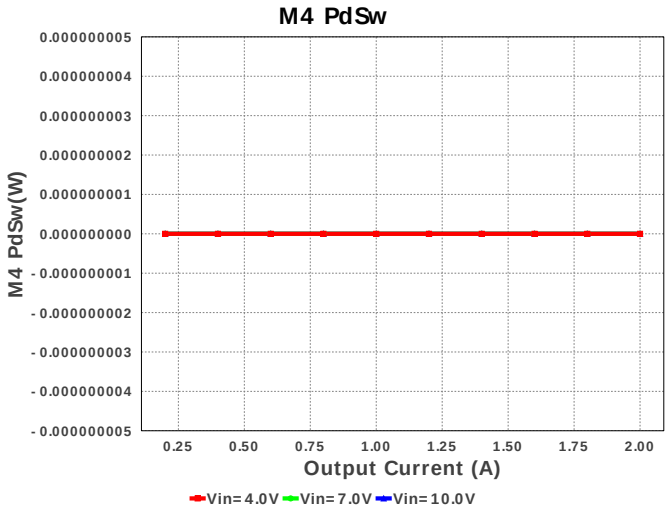


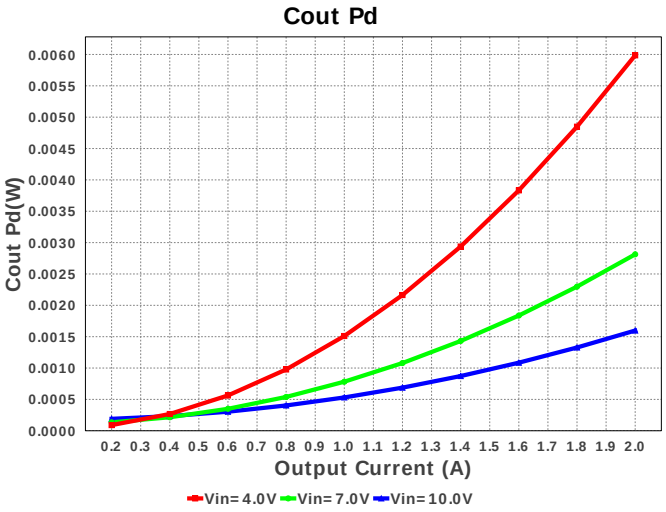


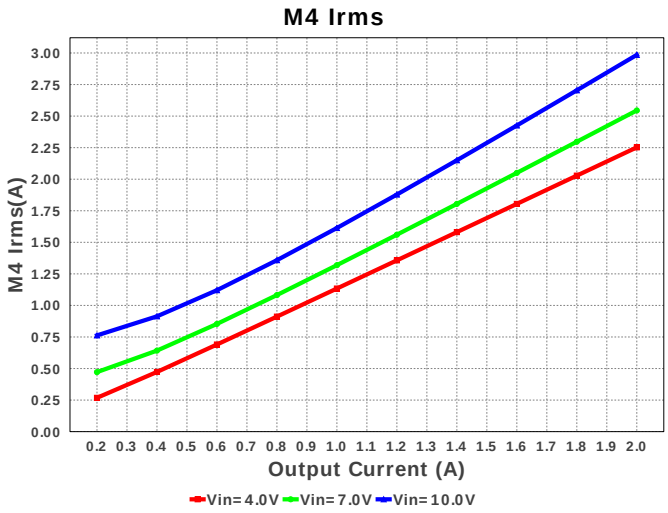


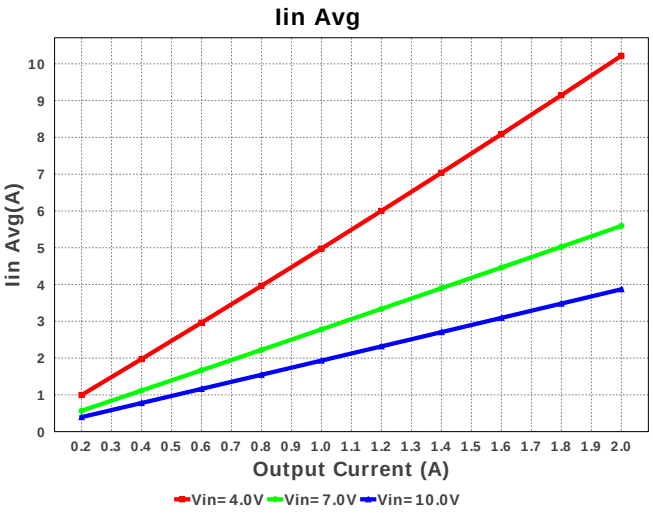


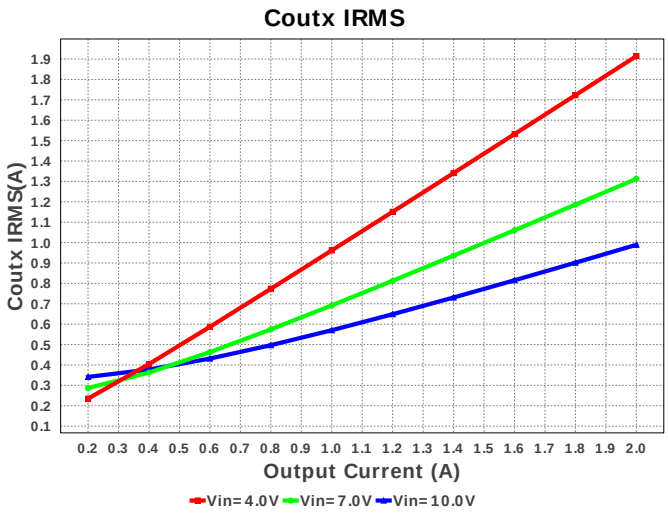


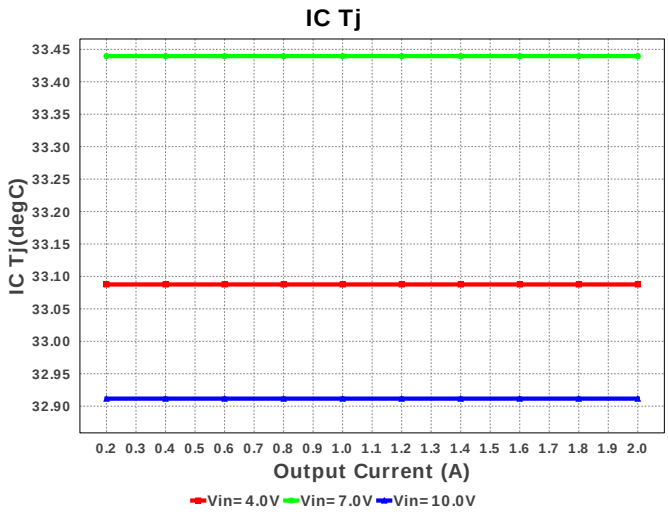


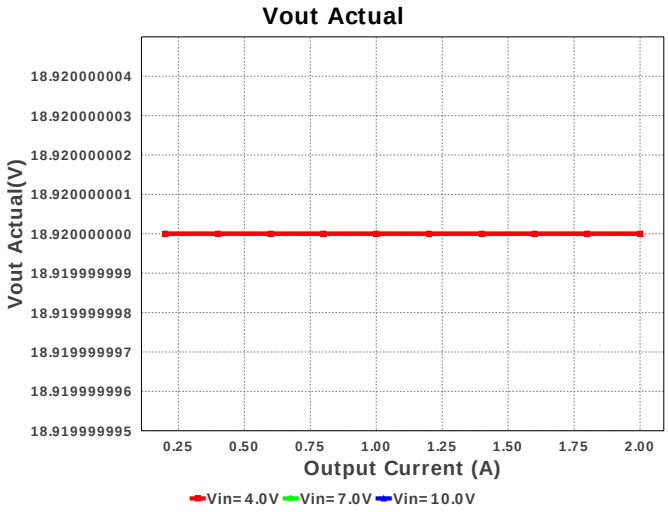


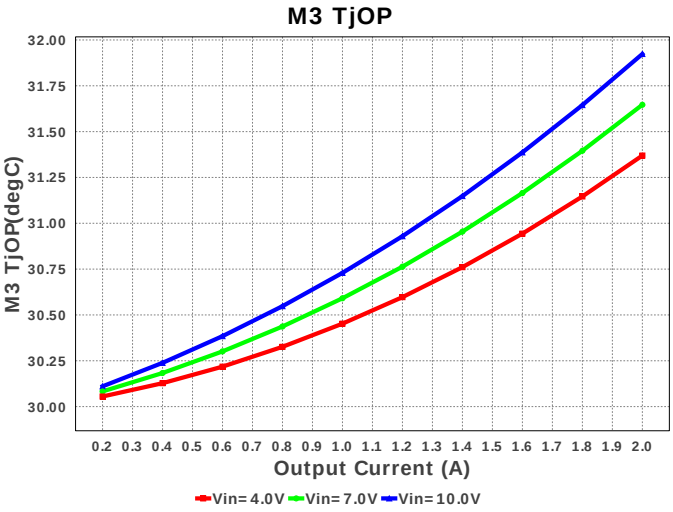


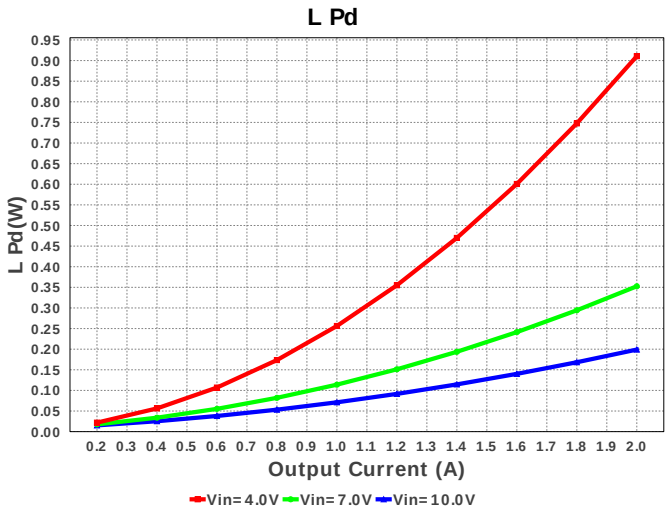


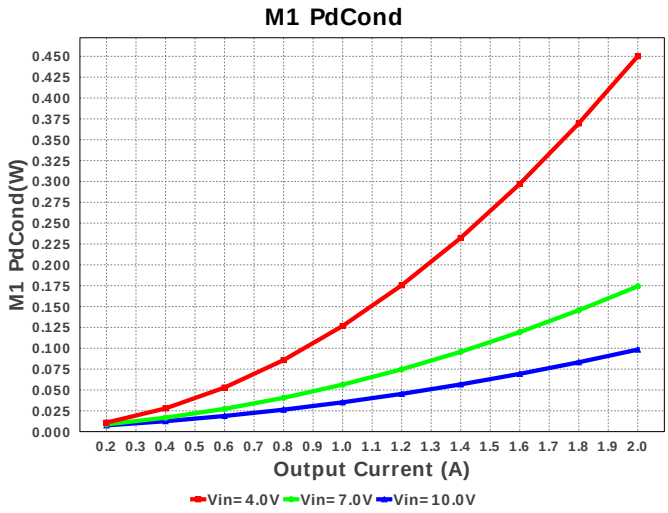


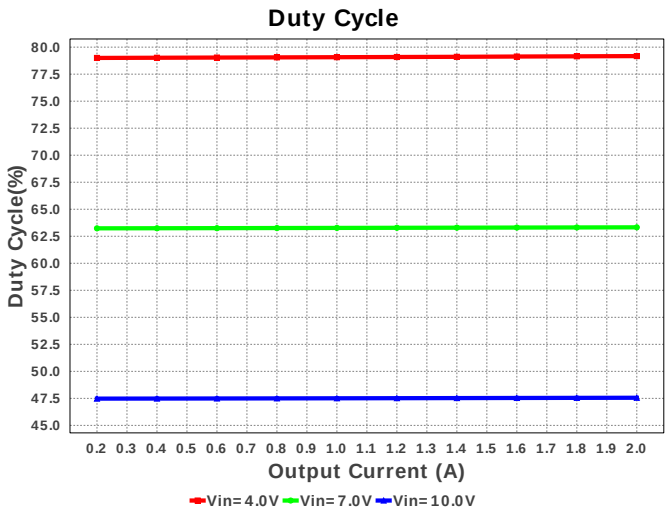


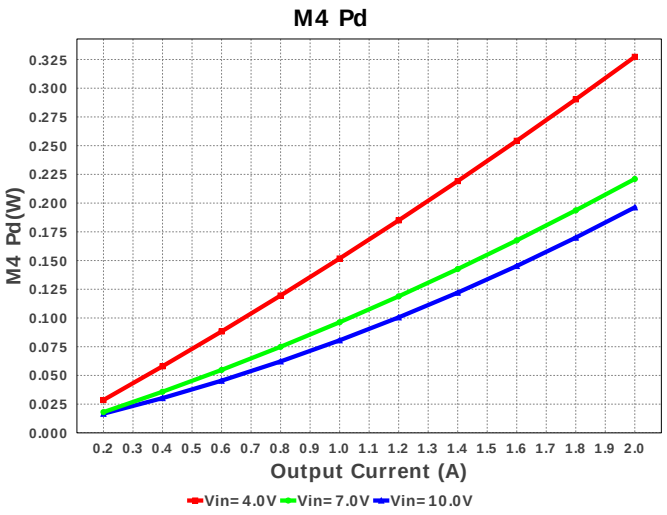


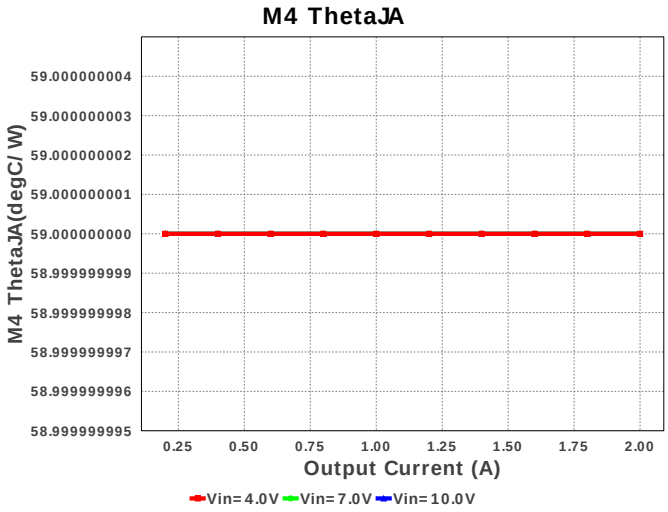


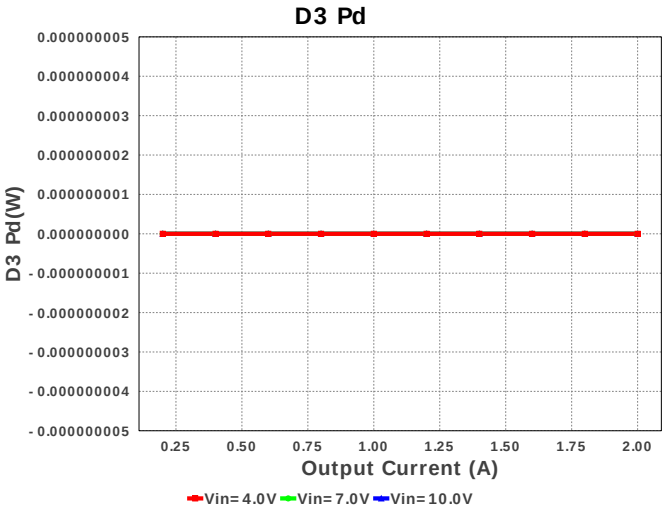


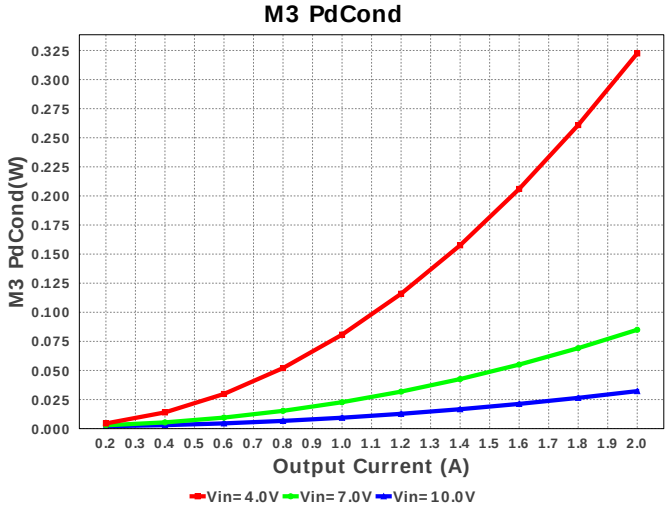


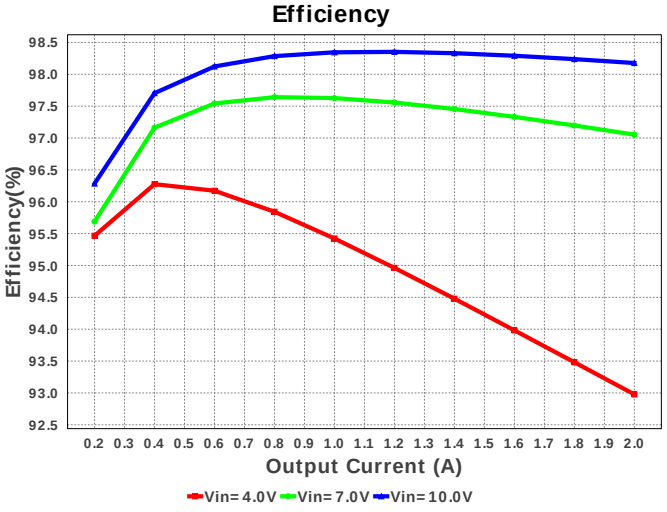


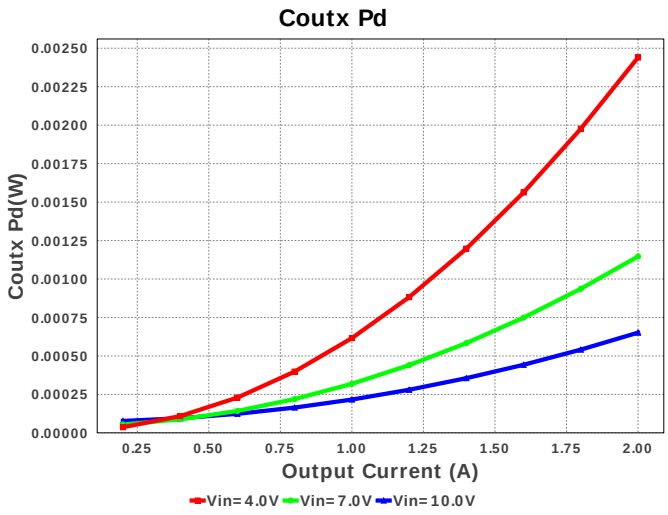


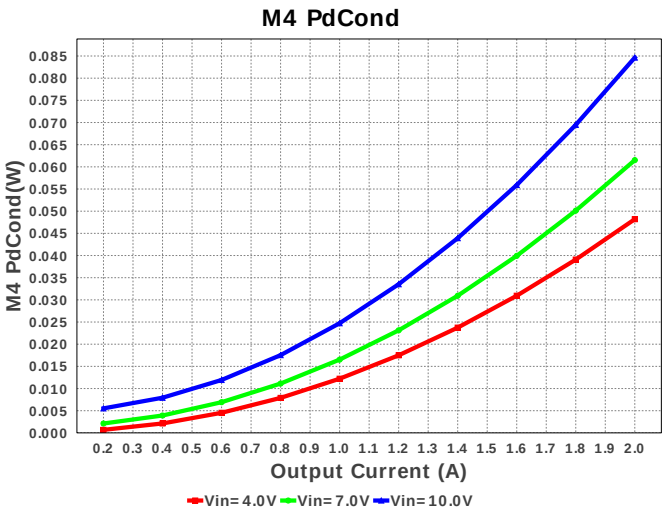


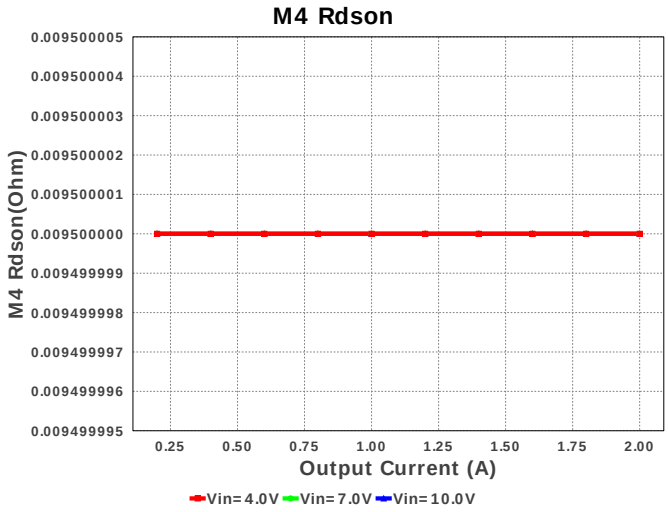


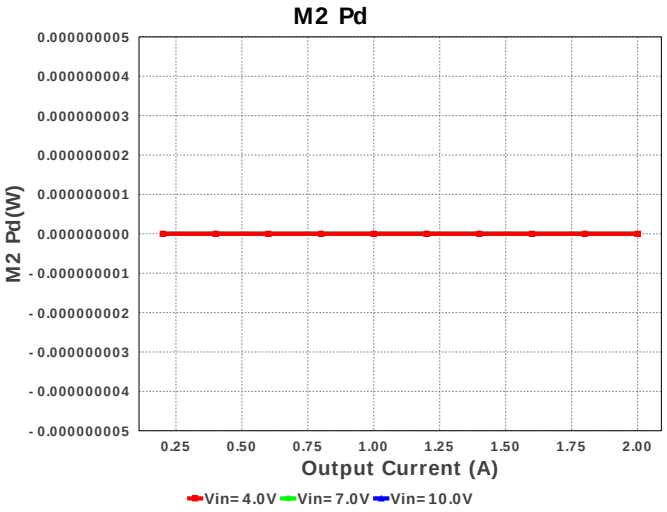


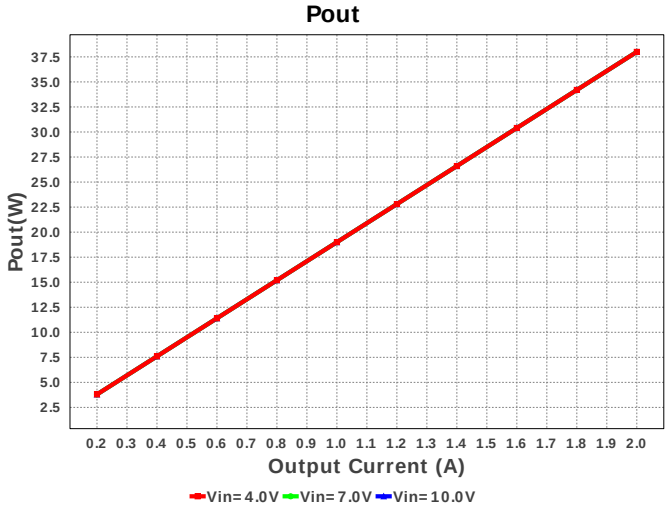


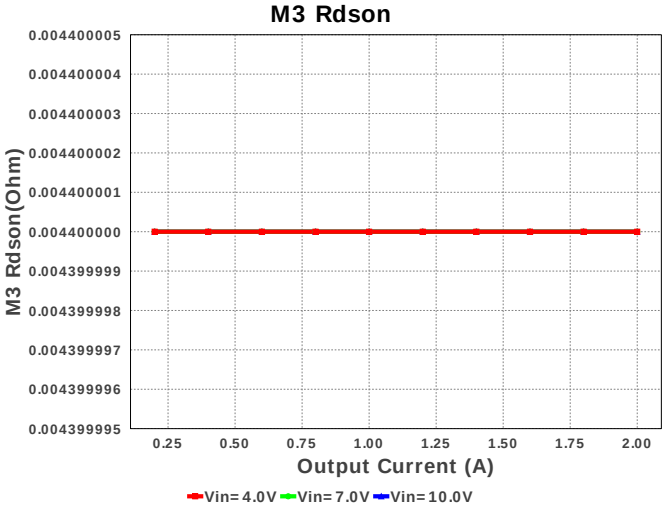


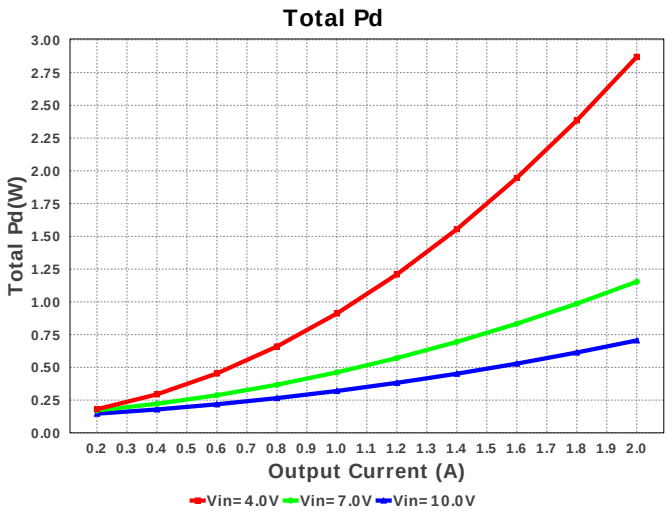


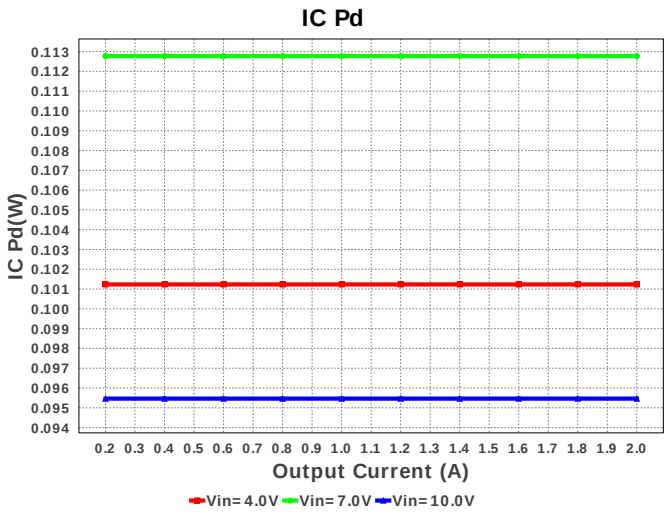


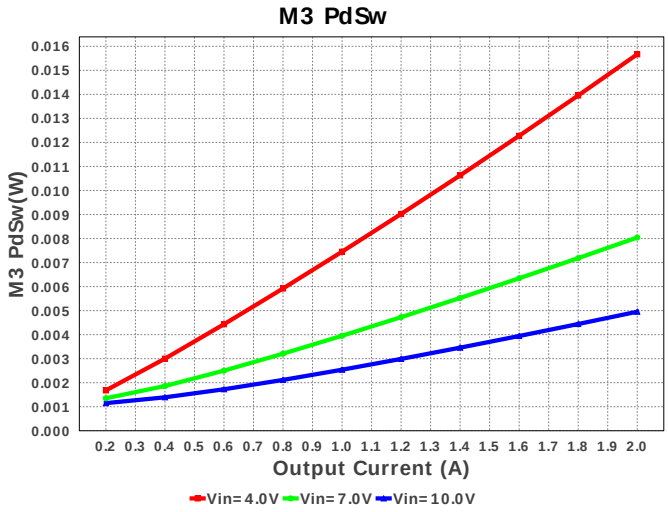


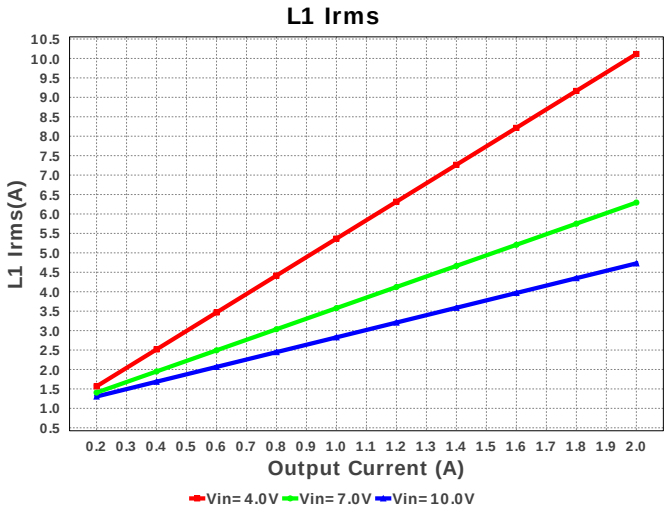


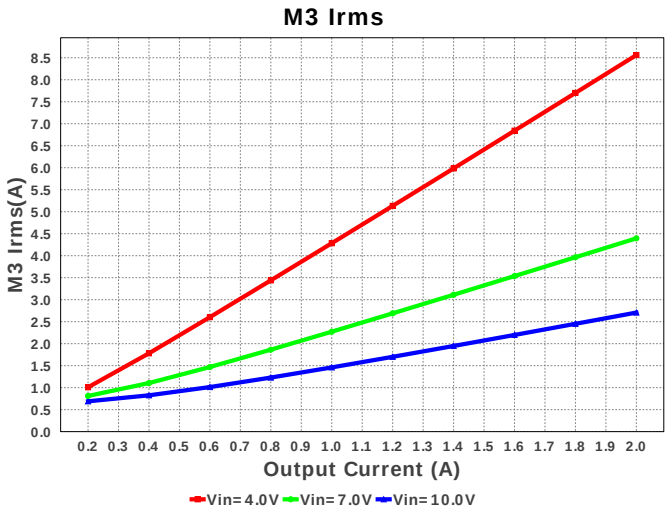


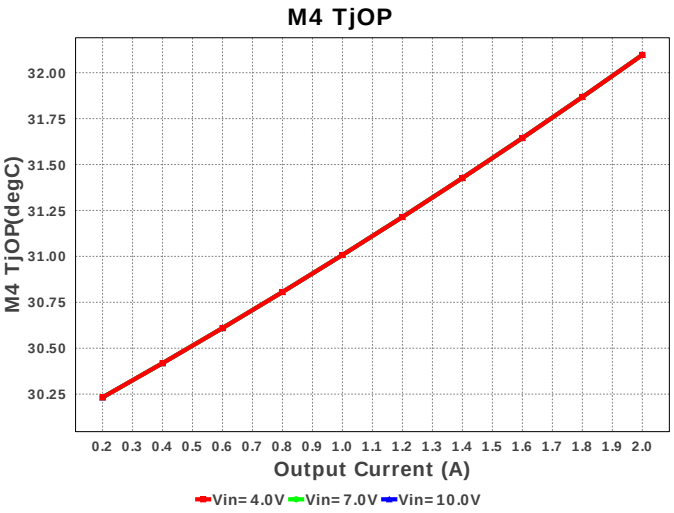


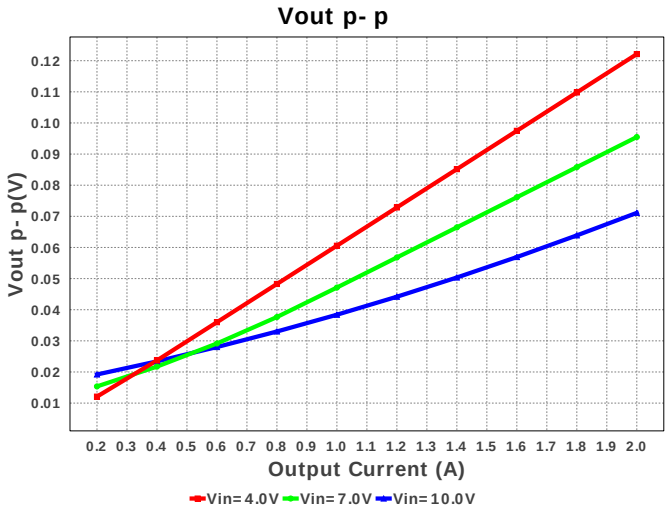


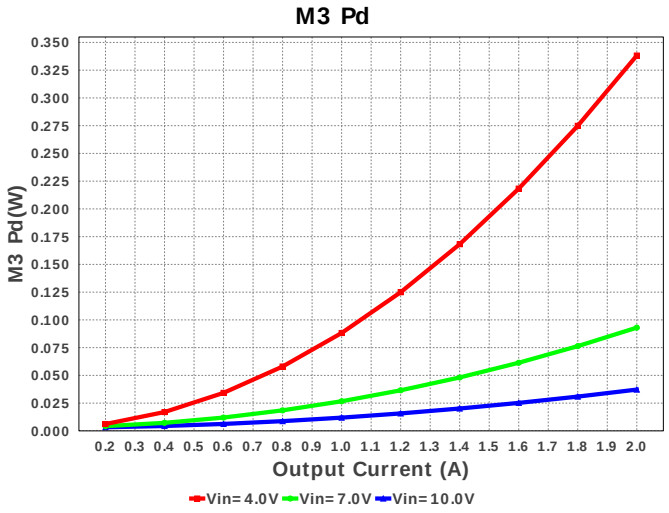


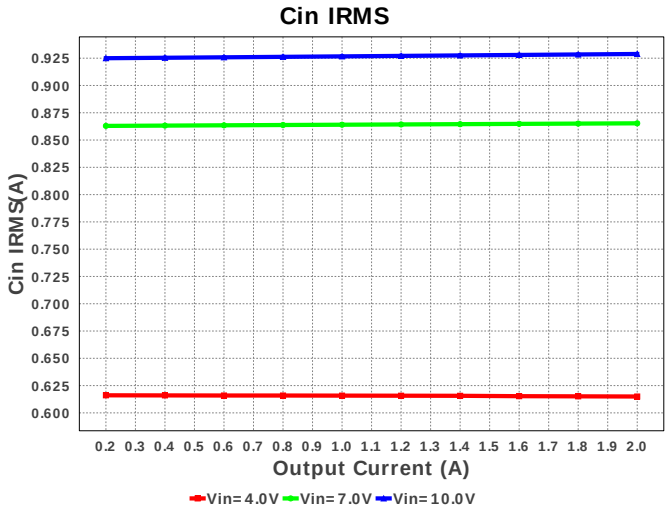


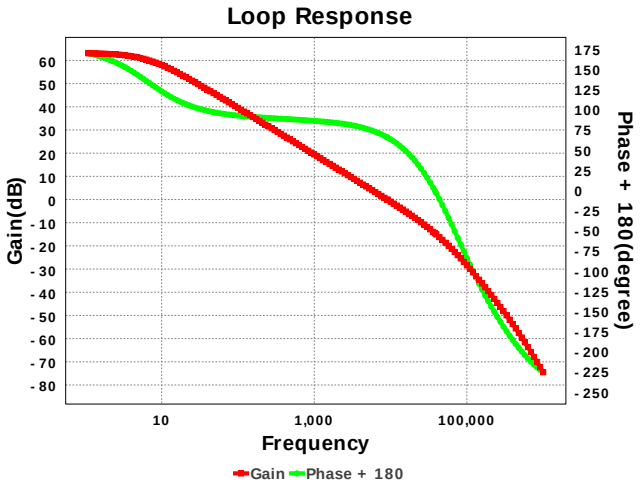












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.541 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	1.127 A	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	1.082 A	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	10.326 A	Current	Average input current
5.	L Ipp	5.34 A	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	11.041 A	Current	Inductor ripple current
7.	M3 Irms	9.222 A	Current	MOSFET RMS ripple current
8.	M4 Irms	2.424 A	Current	MOSFET RMS ripple current
9.	SW Ipk	6.488 A	Current	Peak switch current
10.	BOM Count	53	General	Total Design BOM count
11.	FootPrint	944.0 mm^2	General	Total Foot Print Area of BOM components
12.	Frequency	314.248 kHz	General	Switching frequency
13.	IC Tolerance	0.0 V	General	IC Feedback Tolerance
14.	Pout	38.0 W	General	Total output power
15.	Total BOM	$10.03	General	Total BOM Cost
16.	Low Freq Gain	63.066 dB	Op_Point	Gain at 10Hz
17.	M3 TjOP	32.004 degC	Op_Point	MOSFET junction temperature
18.	M4 TjOP	32.323 degC	Op_Point	MOSFET junction temperature
19.	Vout Actual	18.92 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
20.	Vout OP	19.0 V	Op_Point	Operational Output Voltage
21.	Cross Freq	9.044 kHz	Op_point	Bode plot crossover frequency
22.	Duty Cycle	47.623 %	Op_point	Duty cycle
23.	Efficiency	91.997 %	Op_point	Steady state efficiency
24.	Gain Marg	-14.554 dB	Op_point	Bode Plot Gain Margin
25.	IC Tj	32.912 degC	Op_point	IC junction temperature
26.	ICThetaJA	30.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
27.	IOUT_OP	2.0 A	Op_point	Iout operating point
28.	Phase Marg	66.37 deg	Op_point	Bode Plot Phase Margin
29.	VIN_OP	4.0 V	Op_point	Vin operating point
30.	Vout p-p	73.686 mV	Op_point	Peak-to-peak output ripple voltage
31.	Cin Pd	9.805 mW	Power	Input capacitor power dissipation

#	Name	Value	Category	Description
32.	Cout Pd	1.912 mW	Power	Output capacitor power dissipation
33.	Coutx Pd	779.329 µW	Power	Output capacitor_x power loss
34.	D2 Pd	0.0 W	Power	Diode power dissipation
35.	D3 Pd	0.0 W	Power	Diode power dissipation
36.	IC Pd	95.464 mW	Power	IC power dissipation
37.	L Pd	1.085 W	Power	Inductor power dissipation
38.	M1 Pd	536.415 mW	Power	M1 MOSFET total power dissipation
39.	M1 PdCond	536.415 mW	Power	M1 MOSFET conduction losses
40.	M2 Pd	0.0 W	Power	M2 MOSFET total power dissipation
41.	M3 Pd	391.076 mW	Power	MOSFET power dissipation
42.	M3 PdCond	374.199 mW	Power	M1 MOSFET conduction losses
43.	M3 PdSw	16.877 mW	Power	M1 MOSFET switching losses
44.	M3 Rdson	4.4 mOhm	Power	Drain-Source On-resistance
45.	M4 Pd	334.937 mW	Power	MOSFET power dissipation
46.	M4 PdCond	55.807 mW	Power	M2 MOSFET conduction losses
47.	M4 PdSw	0.0 W	Power	M2 MOSFET switching losses
48.	M4 Rdson	9.5 mOhm	Power	Drain-Source On-resistance
49.	Rsense Pd	850.452 mW	Power	LED Current Rsns Power Dissipation
50.	Total Pd	3.306 W	Power	Total Power Dissipation
51.	M3 ThetaJA	55.0 degC/W		MOSFET junction-to-ambient thermal resistance
52.	M4 ThetaJA	59.0 degC/W		MOSFET junction-to-ambient thermal resistance
53.	Vout Tolerance	1.935 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	10.0	Maximum input voltage
3.	VinMin	4.0	Minimum input voltage
4.	Vout	19.0	Output Voltage
5.	base_pn	LM5175	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. Tip: Snubbers and/or gate resistors may be required to limit the SW1,2 node switching spikes below the IC and FET abs max ratings.

2. Tip: Slope Capacitor: smaller slope capacitors provide better transition region behavior.

3. **LM5175** Product Folder : http://www.ti.com/product/LM5175 : contains the data sheet and other resources.